

INCORPORATING GAMES FOR CULTURALLY AND LINGUISTICALLY DIVERSE
STUDENTS IN MATH CLASSROOMS

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by
Kennia Patricia Fuentes Amador

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Advisor: Prof. Paula Wilder

Abstract

Mathematics is an area where most students struggle. The results obtained from the Nation's report card have identified the need for improvement in this subject. There are approximately 5 million culturally and linguistically diverse (CLD) students in the United States. For CLD students mathematics becomes even more challenging as they have to learn a new language English and the technical vocabulary that math entails. CLD students' curriculum and remedial plans usually focus on acquiring the lower-order thinking skills of Bloom's Taxonomy. In order for this group of students to improve they need to be challenged to experience a productive struggle. It is with this in mind that I designed a teacher-oriented website that promotes the integration of games into mathematics instruction. Games help reduce students' affective filter. They promote the 4C's, collaboration, communication, critical thinking, and creativity, skills that help students become successful in this day and age. By implementing games in the classroom teachers can see an increase in engagement and participation, which can lead to mastery and proficiency.

The website includes resources such as videos that support the theory, effective math practices, benefits of incorporating games into instruction, a variety of teacher curated resources and tutorials on how to implement them.

It is my hope that this website will become a valuable tool for educators who seek to include games into their teaching.

Dedication

I dedicate this thesis to my dad, who was always my greatest supporter. He taught me to never give up and to always follow my dreams.

To my friends and family who have encouraged me in this endeavor.

Finally, to my husband, for his unconditional support, for the long nights of staying up, keeping me company, and pushing me when I wanted to give up.

Acknowledgments

I would like to acknowledge all the amazing educators who have shaped me and inspired me to be the professional I am today. I am extremely grateful for Dr. Michelle Plaisance and Professor Paula Wilder. Thank you for patience, guidance, and support throughout this process.

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Chapter One: Introduction

The United States Department of Education utilizes the term Culturally and Linguistically diverse to refer to students who are not English Proficient (NEP) or those who have limited English proficiency (LEP). This term is also coined for students who are raised in households where English is not their main language.

Culturally and linguistically diverse (CLD) students encounter social, emotional, and academic struggles. CLD students' curriculum and remedial plans usually focus on acquiring the lower-order thinking skills of Bloom's Taxonomy. The curriculum can oftentimes be repetitional and less challenging. Lower Order Thinking Skills are necessary for students to have a foundation, and the goal is to move on to higher order thinking skills. Even though students may show some difficulties with these skills, they should be exposed to them. This will place learners in a productive struggle. Blackburn (2018) defines the productive struggle as the "sweet spot" between scaffolding and support. The lack of exposition to productive struggle turns students into dependent learners. In order for teachers to better serve their learners, the students need to shift to independent learners.

Educational inequity magnifies what is known as the achievement gap. Researchers attribute this gap to a culture of poverty; however, the reality is learners struggle because educators have not offered them sufficient opportunities to develop the cognitive skills and habits that would prepare them for more advanced tasks (Boykin & Noguera, 2011 as cited in Hammond, 2014).

The National Council of Teachers of Mathematics (NCTM) launched the standards-based education movement in North America with the release of curriculum and evaluation standards

for school mathematics, an unprecedented initiative to promote systemic improvement in mathematics education (National Council of Teachers of Mathematics, 2014). In 2009, the Common Core State Standards were adopted by 48 states, two territories, and the District of Columbia. The purpose of this initiative was to have college and career-ready students by the time they graduated from high school.

In spite of all that has been done in the past 25 years, there is still a range of troubling unproductive realities that exist in many classrooms, schools, and districts. Some of those issues are listed below (National Council of Teachers of Mathematics, 2014).

- The focus on learning procedures without any connection or meaning to the students is high, therefore, students struggle to apply these procedures.
- CLD students are usually placed in lower expectations curricula, they are rarely exposed to higher order thinking skills, therefore few emerge from the remedial tracks that they were initially placed in.
- Teachers encounter a lack of instructional and technological materials that make teaching practices
- The importance that is given to results from high-stakes assessments, which oftentimes emphasize skill and fact recall and fail to give sufficient attention to problem-solving and reasoning.
- There are few opportunities for mathematics teachers to work collaboratively with peers, they typically remain isolated, without the benefits of collaborative structures and coaching, and with inadequate opportunities for professional development related to mathematics teaching and learning.

As a result, few students, in particular those from traditionally under-represented groups, Culturally and linguistically diverse (CLD) students, are attaining high levels of mathematics learning. The goal of creating an online math learning community is to provide strategies for teachers that can help them effectively reach these students.

One of the concerns teachers have stated often is the lack of motivation their CLD students show when faced with a new challenge. One strategy I will be implementing in my project is the usage of games to enhance engagement. Using games not only engages students but they are a tool to increase rigor. Students enjoy playing games, they spend much of their free time playing them and stay playing until they are able to reach the next level. This is what we can extract and use in our classrooms.

Gameful learning refers to integrating the underlying mechanics, or properties, of games, including elements such as user choice, emotional narratives, immediate feedback, and learning from failure, into the fundamental design of a course (Chelsea, 2012; Fishman et al., 2013 as cited in Alexander, J., et al 2019).

Jane McGonigal (2012) describes the effects of game playing in her TED Talk “Gaming can make a better world”. She discusses how people are drawn to playing games, and how games can increase intrinsic motivation in the players to accomplish tasks.

In this paper, I will research the benefits of utilizing gameful learning in the math classroom and other strategies that can be used to increase student performance in the mathematics classroom. The website will include different strategies that teachers can use to increase student engagement and performance in the CLD Math classroom.

Chapter 2: Literature Review

Introduction

In this chapter, I will examine the research involving the Common Core State Standards for Mathematics in the fifth grade and the implementation of gameful learning and best practices in the culturally and linguistically diverse math classroom.

Culturally and Linguistically Diverse Students' Challenges

The United States school system currently has over 5 million culturally and linguistically diverse students. Even though the number of CLD students is increasing, this does not mean that their needs are being met. Peregoy and Boyle (2017) described schools as the primary source of adaptation to the language and culture of American society. Research has consistently shown that teachers are the single most influential factor associated with student learning and academic achievement (Okilwa & Robert, 2018). Schools should provide teachers with adequate professional development in order for them to successfully teach their CLD population.

In her research, Brown (2005) explored the underlying reasons why math is an area of struggle for culturally and linguistically diverse students. CLD students must filter their math knowledge through a second language. Therefore, math becomes a language of its own. Students are challenged when learning cognitively demanding and abstract mathematical concepts while still learning English. In addition to this, math vocabulary is not used regularly because it is technological and narrow. Language is a tool for math learners due to the fact that assessments contain difficult and unfamiliar vocabulary, which is why CLD students battle with word

problems (Jourdain & Sharma, 2016). Another aspect of why CLD students have difficulty with word problems is due to cultural differences when presented with a word problem that contains specific mainstream references such as Groundhog Day or Black Friday. Students are not aware of the cultural context these holidays are referencing.

The No Child Left Behind Act implemented in 2001 was created to close the gap in test scores between African American and White students. CLD students have traditionally underperformed in comparison to their English peers. In 2009, the Common Core State Standards were adopted by 48 states, two territories, and the District of Columbia (Abedi et al., 2006). The purpose of this curriculum was to improve mathematics proficiency among all groups, including CLD students.

Common Core State Standards

The Common Core concentrates on a clear set of math skills and concepts. Students will learn concepts in a more organized way both during the school year and across grades. The standards encourage students to solve real-world problems (Common Core State Standards Initiative, 2021).

The learning of mathematics includes the development of five interrelated strands that when combined constitute mathematical proficiency (The National Research Council 2001). The strands are as follows (The National Research Council, 2001):

1. Conceptual understanding (Students being able to comprehend and connect concepts, operations, and mathematical relations).
2. Procedural fluency (Students being able to explain procedures used to solve problems).

3. Strategic competence (Students being able to formulate, represent, and solve problems).
4. Adaptive reasoning (Students being able to justify their answers).
5. Productive disposition (Students being able to see the sense in math and its usage).

These strands are interconnected. In order for students to be able to reach a productive disposition, they need to have acquired the prior strand. Once they have reached the conceptual understanding, they move on to the procedural fluency, then to the strategic competence until they are able to reach the productive disposition. The Common Core State Standards for Mathematics is divided into domains; furthermore, these domains increase complexity as students move on to higher grade levels. For the fifth grade, teachers focus on the following domains (Common Core State Standards Initiative, 2021).

- Operations and Algebraic Thinking: To acquire proficiency in this domain students need to adequately understand how to write and interpret numerical expressions and patterns.
- Number and Operation in Base Ten: For students to develop fluency in this domain, students need to comprehend the place value system and how to perform operations with multi-digit whole numbers and decimals.
- Number and Operations in Fraction: In order for students to be successful in this domain, students need to apply their knowledge of multiplying and dividing fractions. They also need to add and subtract fractions using equivalent fractions.

- Measurement and Data: To become proficient in this domain, students need to read and interpret different kinds of data. They also need to convert between measurement units.
- Geometry: Students need to graph points on a coordinate plane to solve real-world problems.

Best Mathematical Practices

Students need to shift from dependent to independent learners to become successful academically. Learning happens over a period of time, students need to be actively engaged in the learning process, so they can incorporate what they learn and make it part of themselves (Di Muro, 2006). Teachers play an important role in this. When planning a lesson, teachers need to think about what their students' needs are, how they can be met, and which strategies are needed to best deliver the lesson. Differentiated instruction is one of the most effective ways for teachers to meet students' needs. When teachers differentiate instruction, they are consciously making the content, processes, and outcomes of instruction more accessible to all learners. (Chien, 2012). The National Council of Teachers of Mathematics (NCTM) provides a framework for eight effective mathematics teaching to enhance student learning (National Council of Teachers of Mathematics, 2014).

Establish mathematics goals to focus learning.

One defines clear and attainable goals for students. The goals indicate what students are to learn and understand as a result of instruction. Students need to have a clear idea of what they are learning, why it is important, how it relates to previous learning, and how they can apply it in

real life. Teachers can gauge student understanding and use this to guide their lesson planning (National Council of Teachers of Mathematics, 2014, p. 12). Marzano (2003) mentioned that goals or essential questions motivate learning when students perceive the goals as challenging but attainable. This practice prepares the brain for a productive struggle, which in turn grows our brain power (Means & Knapp, 1991).

Implement tasks that promote reasoning and problem solving.

Student learning is maximized when the tasks encourage high-level student thinking and reasoning. Effective teachers need to implement tasks that promote reasoning and problem solving (National Council of Teachers of Mathematics, 2014, p. 17). They are aware of contexts, culture conditions, and language to create tasks that draw on students' prior knowledge and life experiences (Cross et al., 2012).

Use and connect mathematical representations.

There are several types of mathematical representations: visual, symbolic, verbal, contextual, and physical. Using these different representations provides students to see concepts through different perspectives (Tripathi, 2008). Students should view problems from different viewpoints. Visual representations can help students get a better understanding of abstract concepts and help her engage in mathematical discourse.

Facilitate meaningful mathematical discourse.

Mathematical discourse includes the purposeful exchange of ideas through classroom discussions (National Council of Teachers of Mathematics, 2014, p. 17). It gives students the opportunity to share ideas and clarify understandings, construct arguments, and develop a

language for expressing mathematical ideas (National Council of Teachers of Mathematics, 2000). Students need to be active participants in these mathematical discourses. Smith and Stein (2018) mentioned five practices for whole-class student response, and these are stated below.

- Anticipating students' responses prior to the lesson. Teachers need to think ahead of how their students might interpret a problem, the different strategies they could use to solve it whether they are correct or incorrect, and how those strategies relate to the concepts that are being taught (Smith & Stein, 2018, p. 10).
- Monitoring students' work on and engagement with the tasks. This practice involves paying close attention to students' thinking and solution strategies as they work on the task. It involves more than circulating the classroom and listening to student interactions. Teachers need to ask students' questions that will make their thinking visible, giving them an opportunity to refine or revise their thinking (Smith & Stein, 2018, p. 11).
- Selecting particular students to present their mathematical work. By selecting students to show their work, students can compare strategies, therefore, promoting mathematical discourse (Smith & Stein, 2018, p. 13).
- Sequencing students' responses in a specific order for discussion. Teachers need to make purposeful choices about the order in which students present to maximize the chances of achieving their mathematical goals for the lesson (Smith & Stein, 2018, p. 13).
- Connecting different students' responses and connecting the responses to key mathematical ideas. Teachers can help students make judgments about the consequences of different approaches for the range of problems that can be solved or to identify

patterns that connect one concept to another. It is important to note that these strategies build on each other (Smith & Stein, 2018, p. 14).

One potential barrier to accessing discourse is students' English language proficiency.

Banse et al. (2016) proposed the following strategies for scaffolding CLD students during discourse.

- Ask open-ended questions of all students, this will give CLDs to explain their thinking. Teachers should also have an academic wall, students will learn the mathematical vocabulary (Banse et al., 2016, p. 102).
- Scaffold CLDs with close-ended questions, using follow-up questions that teachers can use to guide students who are grappling with a more complex question (Banse et al., 2016, p. 104).
- Scaffold response by revoicing. Teachers should repeat, extend, and re-articulate students' responses using mathematical language that is more precise (Banse et al., 2016, p. 105)
- Model vocabulary in context. Math has its own language, when students are exposed to in context vocabulary, they can incorporate it and use it in their daily lives more effectively (Banse et al., 2016, p. 106).
- Strive to engage CLD students in discourse each day. Teachers need to empower students to participate in mathematical discourse (Banse et al., 2016, p. 106).

Pose purposeful questions.

Purposeful questions allow teachers to discern what students know and adapt lessons to meet different levels of understanding. These kinds of questions help students make mathematical connections.

Build procedural fluency from conceptual understanding.

When students can connect procedures with concepts, they have better retention and are able to apply them in new situations. This approach supports students in developing the ability to understand and explain their use of procedures, choose flexibly among methods and strategies to solve contextual and mathematical problems, and produce accurate answers effectively. (National Council of Teachers of Mathematics, 2014).

Support productive struggle in learning mathematics.

This practice embraces students' struggles as opportunities to deepen their understanding of the structure of problems. Teachers influence how students perceive and approach struggle. Teachers can create a classroom where mistakes are viewed as a change to grow. Growth mindset which is the mind frame that believes that intelligence can be developed through effort, is crucial for mathematical success in students (Dweck, 2006).

Elicit and use evidence of student thinking.

Effective teaching of mathematics uses evidence of student thinking to assess progress, this includes identifying indicators of what is important to notice in students' mathematical

thinking and planning for ways to elicit information. Teachers need to interpret data from formative assessments to make decisions about their instruction.

There are several other practices that can be incorporated into the Math classroom, these eight practices have demonstrated to strengthen the teaching and learning of students' mathematical acquisition and proficiency (National Council of Teachers of Mathematics, 2014).

Benefits of Games

Teachers incorporate games into their teaching to enhance learners' motivation and engagement. Culturally and linguistically diverse students feel less apprehensive towards a new skill when they (Gamlo, 2019). Games engage learners in a way that motivates and encourages perseverance. They can make the classroom a more inviting environment. Games by nature require active participation and reward mastery, lending naturally to the framework of active learning (Mauri et al., 2019). Gamification is a term used to describe the increasing use of games or game mechanics outside of the gaming world, it refers to the integration of elements such as user choice, emotional narratives, immediate feedback, and learning from failure, into the educational environment (Fulton, 2019). Its primary purpose is to integrate differentiated strategies of motivation and engagement into a number of activities, including teaching and learning (Alexander et al., 2019). Students are intrinsically motivated when their basic psychological needs for autonomy, competence, and sense of belonging are met. Motivation is an essential component for learning to happen. The benefits of gamification are supported by the self-determination theory and the self-efficacy theory (Alexander et al., 2019). Self-determination theory is supported when a learning environment fosters a sense of autonomy,

support for competence and sense of belonging (Ryan & Deci, 2000). Self-efficacy theory promotes believing in one's abilities to promote cognitive growth (Ryan & Deci, 2000).

Gamification requires teachers to rethink their course design. It provides students with a wide range of opportunities to show their level of knowledge acquisition and application. Among some of the benefits that can be mentioned are the following (Aljen et al., 2020):

- Promotes student autonomy through meaningful choices. Choices enable personalization of learning, balancing the educator's learning goals with the students' goal and interests. Choice also encourages students to develop their metacognitive skills, it gives the chance to reflect on their learning and progress (Aljen et al., 2020, p. 2).
- Provides room for recovery to encourage risk-taking and exploration while maintaining rigor. In order for students to grow academically they need to take risks, we need to engage them in a productive struggle with a low affective filter, which is what games provide. Students are more likely to seek challenges and see failures as learning opportunities (Aljen et al., 2020, p. 2).
- Builds competence through authenticity. Utilizing games during class can help students develop disciplinary skills, frameworks, and thinking skills. It sets students in an authentic learning environment, where they can self-assess and obtain mastery through practice (Aljen et al., 2020, p. 3).
- Cultivates belongingness to foster success for all students. Taking into consideration that a student's sense of belonging is a primary factor in student success and is often associated with academic achievement and persistence. This sense of belonging has been demonstrated to lower performance gaps for CLD students. Games promote inclusivity

by clearly communicating the rules and expectations, students can make better choices if they understand their available choices and the expectations (Aljen et al., 2020, p. 3).

Using Games in the Math Classroom

Games can promote logical reasoning and deduction skills. Maurer et al. (2019) conducted a study to research what students gain from games. Maurer et al. compared the performance of two groups of college students in a short lab activity. The first lab activity used an analogous worksheet, and the second lab activity used the game “Stake your Claim” to expand the students’ knowledge about statistics. Both groups took a pre and post assessment to compare the results. While both groups had stronger understanding of the topic after the lab activity, the group who played the game showed more engagement and student participation; however, the other group still showed growth in their ability to understand probability. While this case study does not portray a significant difference between the two groups observed, it does set the scenario for what can be created in the elementary classrooms. Taking into consideration Maurer’s and his team’s reflection, teachers need to evaluate their students’ backgrounds, and learning styles, to effectively use games to increase rigor, student engagement, and participation while also improving their proficiency (Maurer et al., 2019).

Conclusion

Math is a subject where most students struggle. Culturally linguistically and diverse students have to learn the language of mathematics. Educators have to incorporate a variety of strategies into their instruction to keep their students engaged and participating. Gamification can provide students the opportunity to work together. Collaborative learning is a powerful tool for

all students, particularly for culturally and linguistically diverse students. When English language learners are able to work alongside a partner, they are given the opportunity for interaction and support, which enhances their learning (Jourdain & Sharma, 2016). Games also provide students with an authentic learning experience and multiple problem-solving opportunities. By using the National Council of Teachers of Mathematics framework, teachers can enhance student learning.

Chapter 3: Project Design

In this chapter, I will explain the rationale behind creating a website to help educators implement games or game-like scenarios into a culturally and linguistically diverse math classroom. This website will refer to the eight effective strategies for teaching mathematics proposed by the National Council of Teachers of Mathematics (National Council of Teachers of Mathematics, 2014). In schools, Culturally and Linguistically Diverse (CLD) students typically underperform academically as compared to their peers. Math is a subject that is highly demanding. Jourdain and Sharma (2016) noted, “It is undeniable that language and mathematics are connected in mathematics learning” (p. 44). Educators need to be aware of the difficulties surrounding the teaching of mathematics to CLD students and how to plan their instruction based on those needs. Gonzalez et. al., (2011) discussed the importance of planning because “instructional strategies that facilitate instruction and assessment need to be based on comprehension of content through meaningful activities and assignments” (p. 25).

In his research, Chien (2012) indicated that “Differentiated instruction is a way to meet the needs of diverse students” (p. 280). When educators differentiate instruction, they are making the content and processes relevant to all students. Huh and Lee (2019) stated that due to the need to teach their students to be competent individuals, educators need to prepare their students for the daily challenges they might encounter.

One way to differentiate instruction is to use games. Students spend a vast amount of their leisure time playing games whether online or offline. By applying the elements of a game to teaching, we can increase student engagement and mathematical proficiency (Hanson-Smith, 2016). McNeil (2018) noted that a game-enhanced approach to teaching seeks to maximize

learning. By creating these activities, teachers can support a host of L2 (second language learning) skills and competencies that range from vocabulary to multiple literacies. The concept of gamification is not a new trend. Educators have used gold stars, leaderboards, and incentive charts to gauge and modify student behavior.

Pang (2010) pointed out that creating interactive activities and encouraging students' participation can increase students' acquisition of a new language. Language plays an important role in CLD students' mathematical proficiency. In the upper elementary grades, math contains word problems, which can be an area of struggle for CLD students due to the language and context in which they are written. Perego and Boyle (2017) mentioned that any lesson can be enhanced by a relevant game which can improve student learning and attitude.

Games foster the skills necessary for navigating a complex, interconnected, and rapidly changing 21st century (Smith, 2016). Technology is constantly evolving, so education also needs to evolve. New technology can support critical thinking, communication, collaboration, and creativity, which are 21st century skills students need to acquire in order to become successful in today's global society (Huh & Lee, 2019).

Games provide a great learning environment, and they make students feel less aware of their mistakes and help them acquire a growth mindset. According to Barata e. al., (2013) good games, unlike traditional learning materials, can deliver information on demand and within context. Students learn to balance challenging difficulties according to their abilities. This prevents students from becoming bored, keeping them engaged and turning into independent learners. Games move the student from extrinsic to intrinsic motivation because they lead to the satisfaction of achievement and mastery (Hanson-Smith, 2016). When students are playing

games, their affective filter is lower, and they can participate more and become active participants of their skill acquisition.

In order for teachers to use this strategy effectively, they need to carefully plan their lessons. They need to think about game mechanics and ask: What is the purpose of the game? How do students defeat the game? How is learning assessed? Game mechanics are defined as methods invoked by instructors, designed to increase student interaction with the subject matter (Alexander et al., 2019). A common example of a game mechanic is the usage of action points, player agency, and risk description. Along with the mechanics of the game, educators also need to be aware of the linguistic demands of their lessons and how they will express those demands in order for CLD students to fully participate (Bresser, 2019).

In this website, I will explain the process of how to turn an activity into a game, which elements need to be incorporated, and how to target effective teaching strategies to improve CLD students' math engagement and proficiency. Ultimately, this website will be a tool for teachers who want to try alternate strategies and incorporate gamification into their classroom. They will find several resources on the website including a list of free websites to incorporate games, teacher-created resources along with video tutorials on how to use them in the classroom.

Chapter 4: The Project

The present project is an educational website oriented for teachers with a focus on how to incorporate games into a culturally and linguistically diverse (CLD) math classroom. The expectation for this website is to be a useful tool for educators who want to increase student engagement and participation in mathematics. This website includes a compilation of teacher-created resources, tutorials, videos, articles and online resources that offer educators multiple ways to teach their students.

It is important to mention the framework for this website refers to the eight mathematical practices the National Council of Teachers of Mathematics proposed for strengthening the teaching and learning of mathematics (National Council of Teachers of Mathematics, 2014). The website alludes the strategies proposed by Banse et al. (2016) for scaffolding CL students during discourse. It also includes research from Aljen et al. (2020) regarding the benefits of incorporating games into the classroom. The website can be accessed through the following uniform resource locator (URL) <https://kenniafuentes.wixsite.com/thesis>

Section 1: Home

In the main menu (Figure 4.1 and Figure 4.2), teachers will find the title of the project, a welcome message for educators, and the contact information for the website creator. Teachers will find links to learn more about best math practices, the benefits of games in the classroom, a list of online interactive games, teacher created games, and finally a section on how to incorporate games in the mathematics classroom.

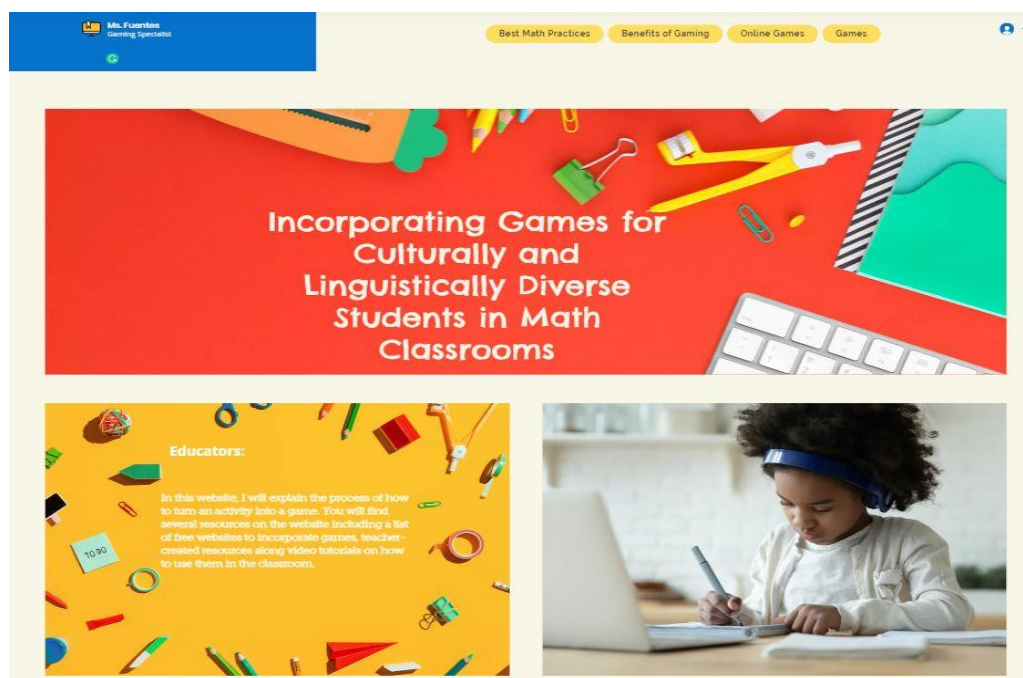


Figure 4.1. Home Page View and Welcome.

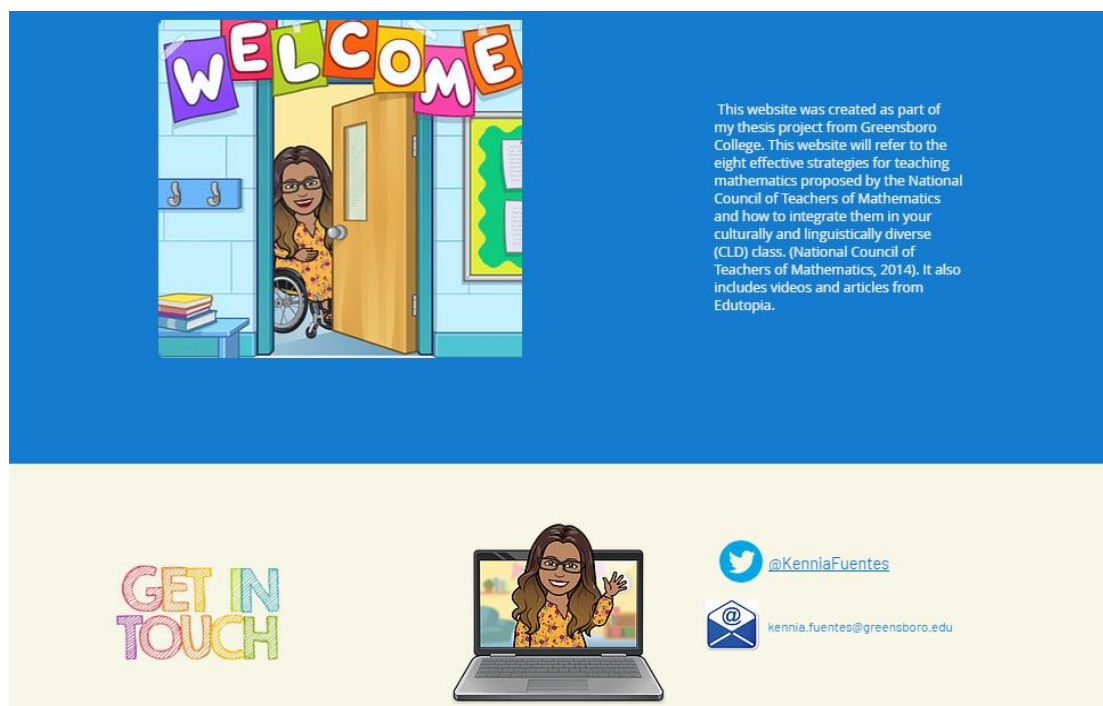
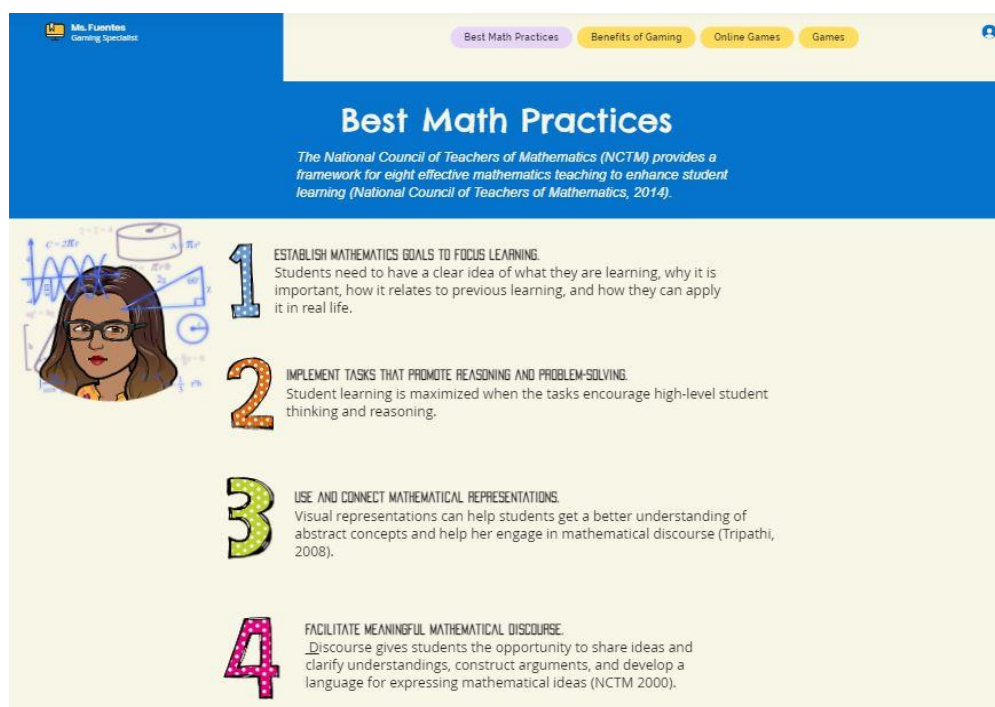


Figure 4.2. Home Page (Bottom half)

Section 2: Best Math Practices

In the link titled Best Math Practices, teachers will find information about the math practices as shown in Figure 4.3 and Figure 4.5. This section includes the videos Encouraging Academic Conversations with Talk Moves depicted in Figure 4.4, which supports math practice 4 that refers to facilitating meaningful mathematical discourse. It also includes the video Math Teaching Models Productive Struggle shown in Figure 4.6, which supports math practice 7 which discusses the importance of productive struggle. This section also includes a guide on how to scaffold discourse for culturally and linguistically diverse students as shown in Figure 4. 7.



Best Math Practices

The National Council of Teachers of Mathematics (NCTM) provides a framework for eight effective mathematics teaching to enhance student learning (National Council of Teachers of Mathematics, 2014).

- 1** ESTABLISH MATHEMATICS GOALS TO FOCUS LEARNING.
Students need to have a clear idea of what they are learning, why it is important, how it relates to previous learning, and how they can apply it in real life.
- 2** IMPLEMENT TASKS THAT PROMOTE REASONING AND PROBLEM-SOLVING.
Student learning is maximized when the tasks encourage high-level student thinking and reasoning.
- 3** USE AND CONNECT MATHEMATICAL REPRESENTATIONS.
Visual representations can help students get a better understanding of abstract concepts and help her engage in mathematical discourse (Tripathi, 2008).
- 4** FACILITATE MEANINGFUL MATHEMATICAL DISCOURSE.
Discourse gives students the opportunity to share ideas and clarify understandings, construct arguments, and develop a language for expressing mathematical ideas (NCTM 2000).

Figure 4.3. Best Math Practices 1-4.

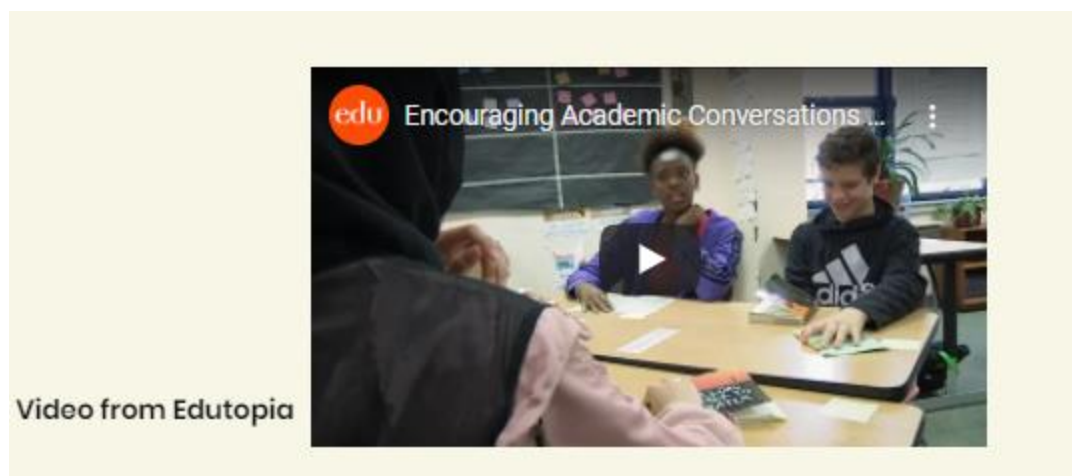





Figure 4.4. Video: Encouraging Academic Conversations with Talk Moves.



POSE PURPOSEFUL QUESTIONS.
 Purposeful questions allow teachers to discern what students know and adapt lessons to meet different levels of understanding. These kinds of questions help students make mathematical connections.



BUILD PROCEDURAL FLUENCY FROM CONCEPTUAL UNDERSTANDING.
 When students can connect procedures with concepts they have better retention and are able to apply them in new situations.



SUPPORT PRODUCTIVE STRUGGLE IN LEARNING MATHEMATICS.
 This practice embraces students' struggles as opportunities to deepen their understanding of the structure of problems. Teachers can create a classroom where mistakes are viewed as a chance to grow.

Figure 4.5. Best Math Practice 5-7.

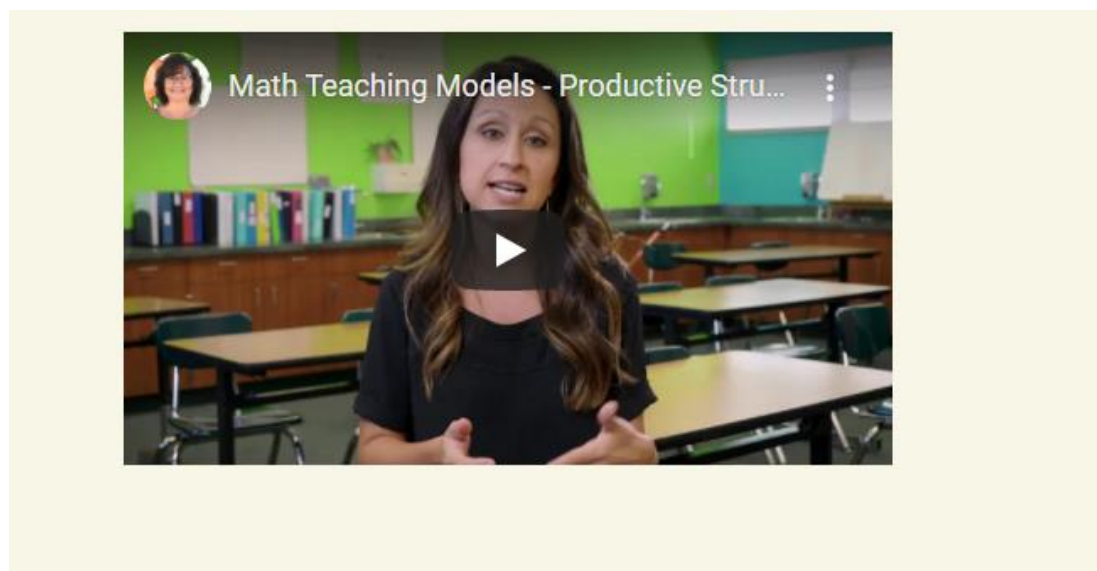


Figure 4.6. Video: Math Teaching Models

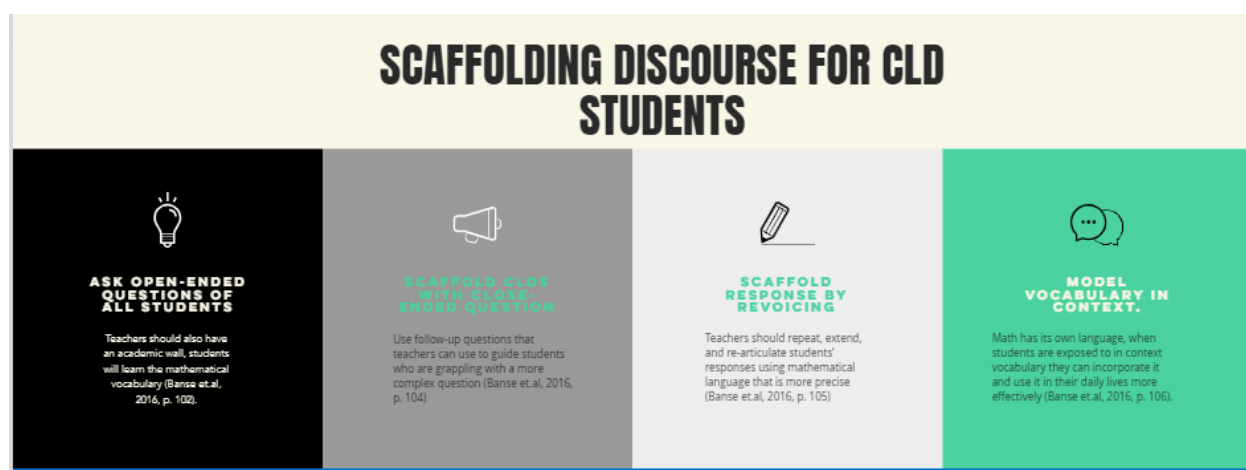


Figure 4.7. Scaffolding Discourse for CLD Students.

Section 3: Benefits of Gaming

Aljen et al., (2020) described four major benefits of gaming which are presented in this section. These can be seen on Figures 4.8 and 4.9. This section includes the video Differentiating Instruction Through Interactive Games, which explores the benefits of using interactive games in

the classroom. Incorporating games is a differentiation strategy that helps students become active participants in their learning.

[Best Math Practices](#)
[Benefits of Gaming](#)
[Online Games](#)
[Games](#)

Benefits of Gaming

Games engage learners in a way that motivates and encourages perseverance. They can make the classroom a more inviting environment. The benefits of gamification are supported by the self-determination theory and the self-efficacy theory.

- Promotes student autonomy through meaningful choices. Choices enable the personalization of learning, balancing the educator's learning goals with the students' goals and interests. Choice also encourages students to develop their metacognitive skills, it gives the chance to reflect on their learning and progress.

- Provides room for recovery to encourage risk-taking and exploration while maintaining rigor. In order for students to grow academically, they need to take risks, we need to engage them in a productive struggle with a low affective filter, which is what games provide. Students are more likely to seek challenges and see failures as learning opportunities.

Figure 4.8. *Benefits of Gaming 1-2.*

3

- Builds competence through authenticity. Utilizing games during class can help students develop disciplinary skills, frameworks, and thinking skills. It sets students in an authentic learning environment, where they can self-assess and obtain mastery through practice.

4

- Cultivates belongingness to foster success for all students. Taking into consideration that a student's sense of belonging is a primary factor in student success and is often associated with academic achievement and persistence. This sense of belonging has been demonstrated to lower performance gaps for CLD students. Games promote inclusivity by clearly communicating the rules and expectations, students can make better choices if they understand their available choices and the expectations.

GAMES AS DIFFERENTIATION



Video from Edutopia

Figure 4.9. Video: *Differentiating Instruction Through Interactive Games*.

Section 3: Online Games

This section titled Online Games includes a variety of educational applications that are game-based. Each application has a link to a tutorial on how teachers can implement this application in their math classroom. It also includes a link to a game of Make 24 and Who Wants to be a Millionaire. This section ends with a video on how Online Math Games Balance Challenge with Mastery Learning.

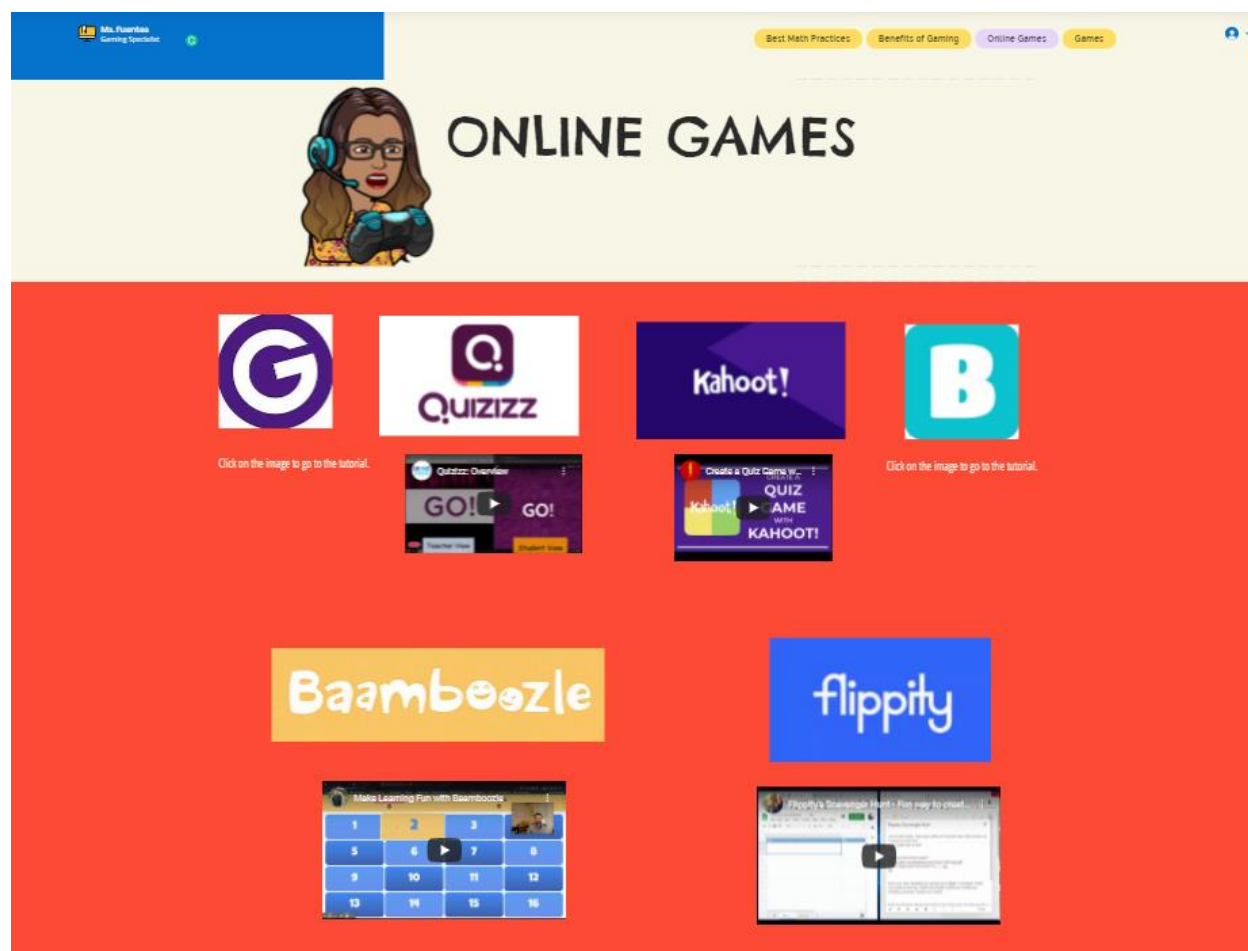


Figure 4.10. Online Games.

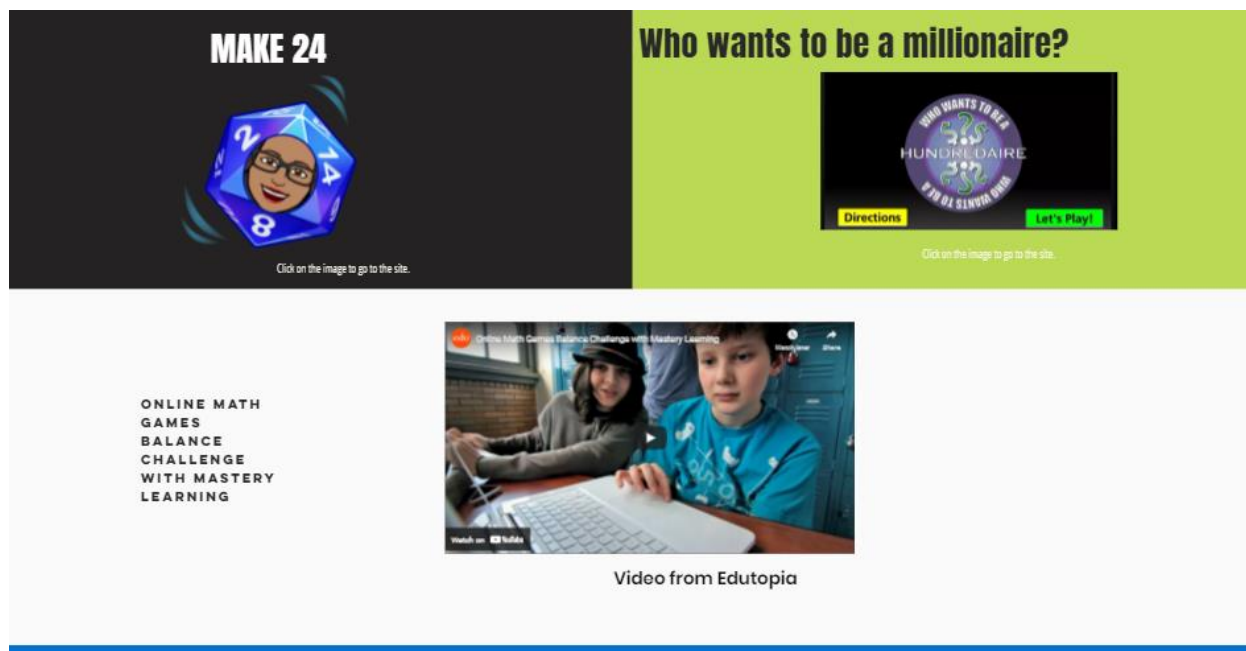


Figure 4.11. Video Online Math Games Balance Challenge with Mastery Learning

Section 4: Games

In this section titled Games, there are multiple teacher-created resources with a clickable link to make a force copy. Teachers can readily utilize and personalize the games and incorporate them into their instruction. This section also includes a tutorial on how teachers can use them in their lesson plans.

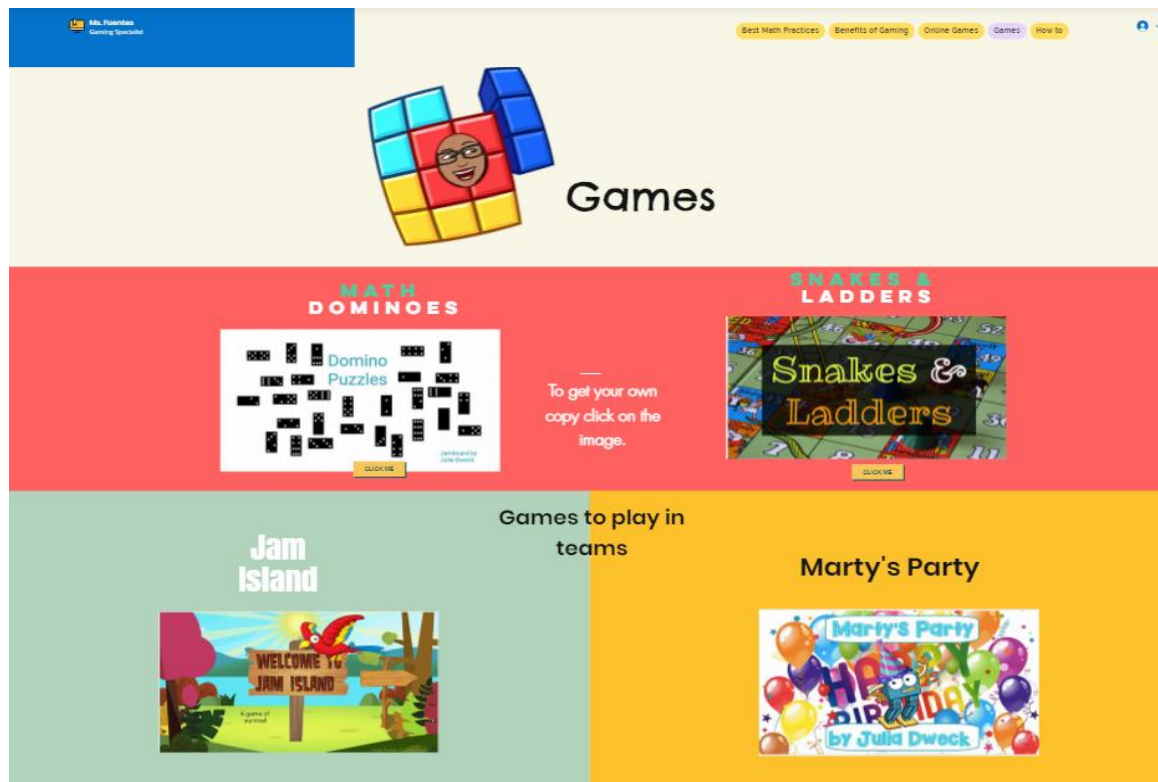


Figure 4.12. Games

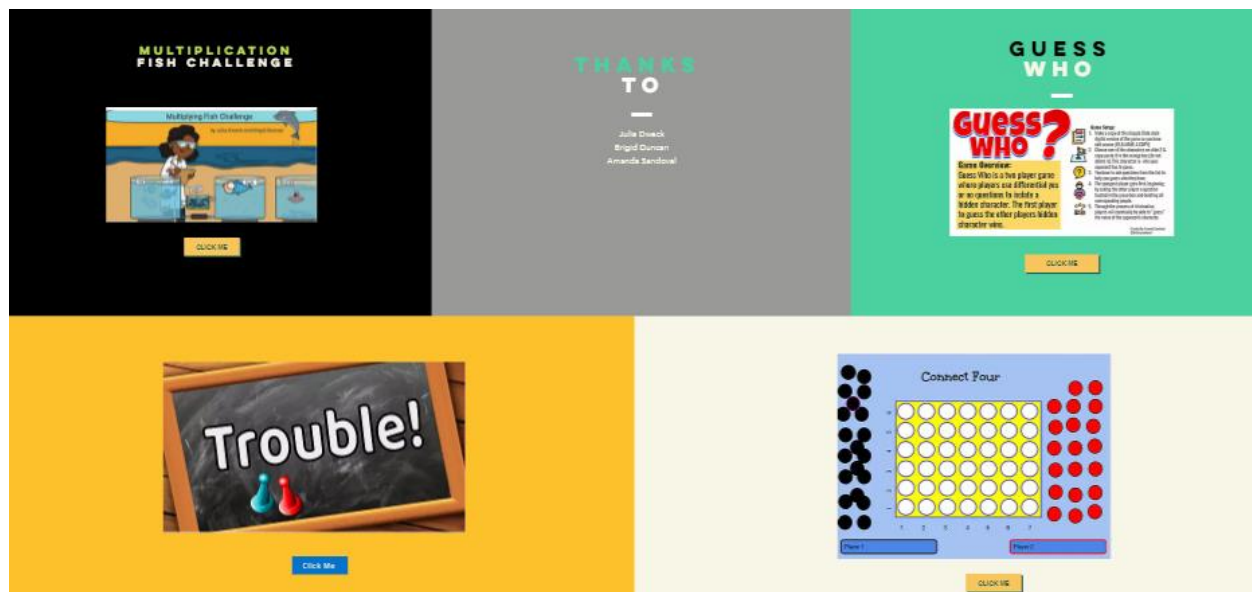


Figure 4.13. Online Games with links

Section 5: How to Gamify

This section includes the steps on how to create a board game. This section also includes links to online math games for teachers to assign to their students. It also includes an article from Edutopia on Getting Started with Game-Based Language Learning and a video on Using Games for Classroom Assessment.

The screenshot shows a website titled "HOW TO GAMIFY" with a navigation bar at the top containing links: "Best Math Practices", "Benefits of Gaming", "Online Games", "Games", and "How to". The main content area has a yellow background with the title "HOW TO GAMIFY" and an illustration of a woman pointing at a laptop screen. Below this, on a red background, is a "Board Game Tutorial" section. It includes a flowchart titled "STEPS FOR IMPLEMENTING GAMES" with five steps: Step #01 (Choose a game), Step #02 (Choose your learning goal), Step #03 (Discuss with students the rules of the game), Step #04 (Assign roles and PLAY), and Step #05 (Feedback (Glow and Grow)). To the right of the flowchart is a "CLICK ON THE IMAGE TO GET A COPY." button. Further right is a "Board Game Tutorial" image showing a board game grid with numbers 1-21 and a "Let's play!" button. A "Click here for tutorial" button is also present.

Figure 4.14. Board Game Tutorial.

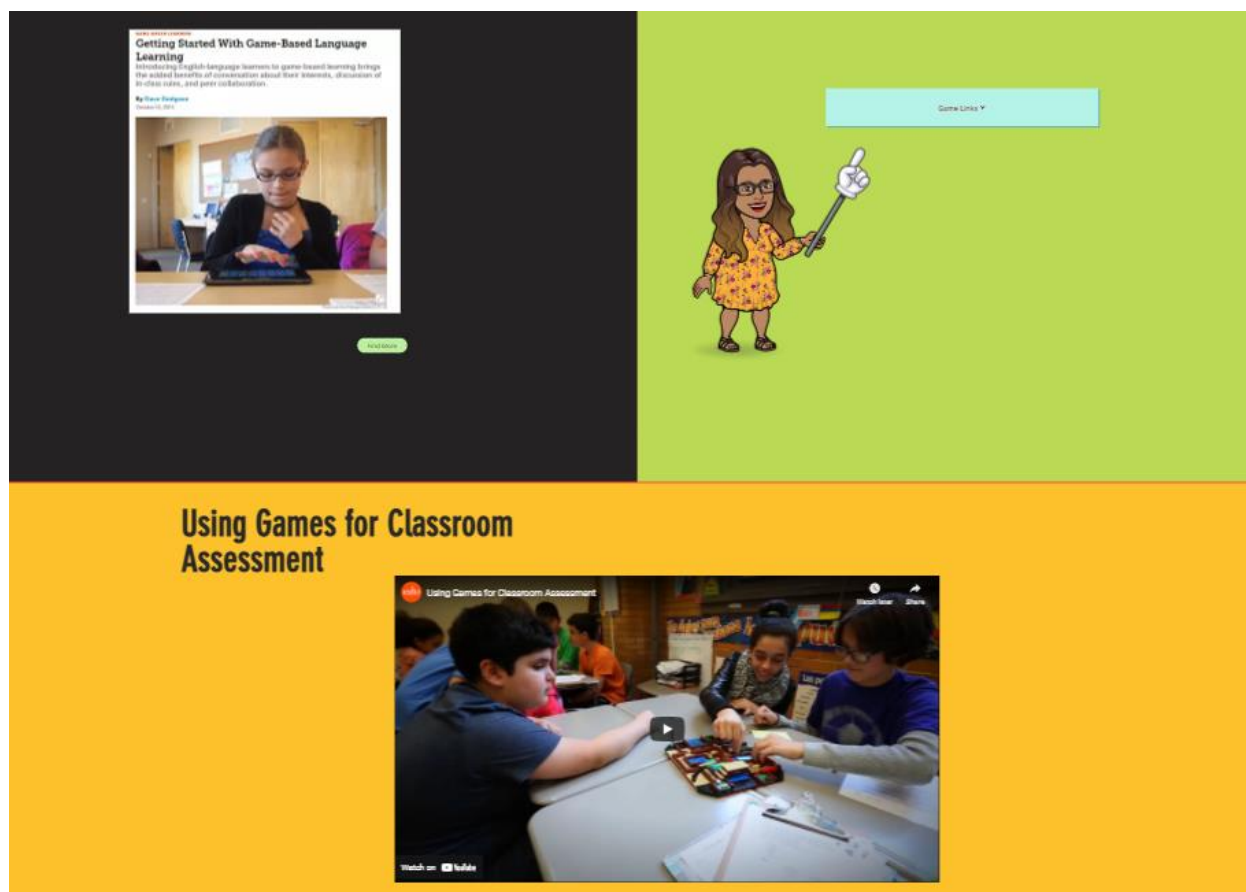


Figure 4.15. Video Using Games for Classroom Assessment.

Chapter 5: Conclusion

During my first year teaching in North Carolina I struggled with math, while I knew the content I was not familiar with the way I was expected to deliver the content to students in the most effective way. I had to learn how to do all basic operations using the common core way. I could relate with the struggles my students were having. Math is an area most students have a hard time. Every year students from grades three and above take an End-of-Grade assessment in reading and math. The purpose of this assessment is to evaluate student performance and mastery of the content taught throughout the school year. The results obtained from the Nation's Report card have shown the need for improvement in math and language arts.

Culturally and linguistically diverse (CLD) students are a group who have traditionally underperformed in comparison to their peers. For CLD students' math poses its innate challenges, but also it includes technical language students might not be familiar with adding another layer of difficulty. In order for students to be successful in math, they need to learn the mathematical language. Students are expected to solve word problems while still acquiring a new language. Teachers need to remember that mathematical learning is also language learning. Educators need to be familiar with the process of second language acquisition regardless of their subject area.

Teachers need to plan their lessons based on their students' needs. One way to do this is by differentiating their instruction. It is important to take into account that differentiated instruction does not only pertain to learning activities, but also includes changing the pace or level of instruction in response to students' needs, levels, and learning styles. I wanted to find a way to have my students enjoy their learning experience that could challenge them without discouraging them.

One way to do this is by incorporating games into instruction. This concept known as gamification is not a new practice. Gamification involves bringing game elements into the classroom. Games share processes with second language learning, such as motivation, feedback, and interaction. Students have grown playing games, they know the mechanics of playing. With the advantage of not having the pressure of performing well in an academic matter, learners are in the game zone. Their minds are ready for challenge, lowering their affective filter which enables them to acquire new skills easier.

By doing this research, I learned that students remain engaged for longer periods of time in some cases teamwork is required which also helps the students interact with their peers, promoting collaboration amongst the students. Integrating games in the classroom does increase participation; however, there is no evidence that it increases mastery or performance, partly because not enough research has been done in this area.

When I started including games into my math classroom my goal was to increase their engagement and hopefully their performance. The idea seemed great; however, planning activities and resources took time and dedication. One of the challenges educators face when attempting to implement gamification is how to properly integrate them while following the learning standards. Another challenge is time, elaborating resources takes a vast amount of time.

My hope is for my website to become a useful tool for educators seeking alternatives so that students can enjoy the learning process. This site can be a teacher's guide on how to start implementing games into their classes with the resources already provided. I also hope for this website to inspire other teachers to try different approaches. I am looking forward to conducting more research on the topic of gamification and its effect on mastery to understand how incorporating games affects the students' learning process.

Appendix

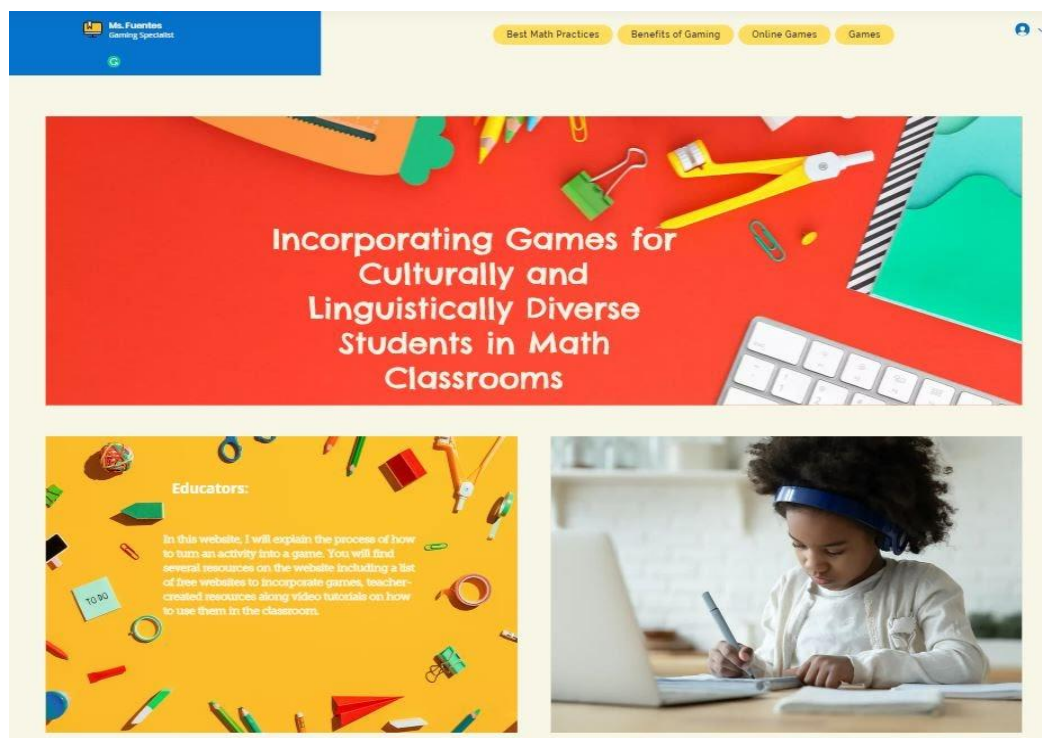


Figure 4.1. Home Page View and Welcome Message.

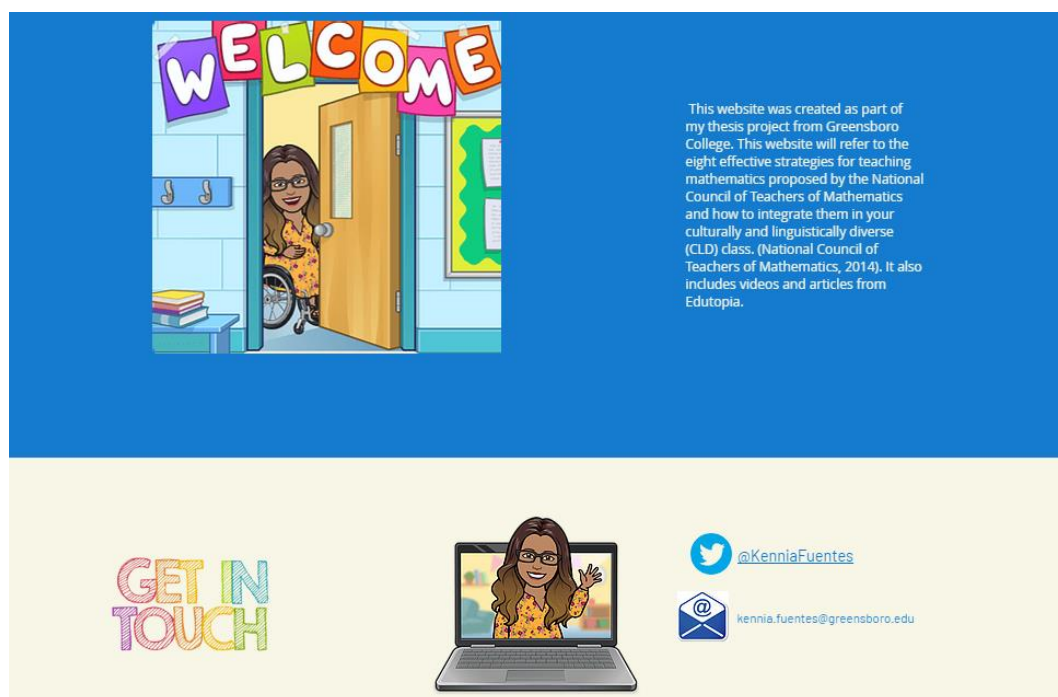


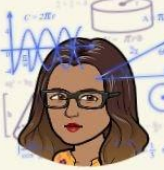
Figure 4.2. Home Page (Bottom half) and contact information.

Ms. Fuentes
Gaming Specialist

Best Math Practices Benefits of Gaming Online Games Games

Best Math Practices


The National Council of Teachers of Mathematics (NCTM) provides a framework for eight effective mathematics teaching to enhance student learning (National Council of Teachers of Mathematics, 2014).

- 

1 ESTABLISH MATHEMATICS GOALS TO FOCUS LEARNING.
Students need to have a clear idea of what they are learning, why it is important, how it relates to previous learning, and how they can apply it in real life.
- 2** IMPLEMENT TASKS THAT PROMOTE REASONING AND PROBLEM-SOLVING.
Student learning is maximized when the tasks encourage high-level student thinking and reasoning.
- 3** USE AND CONNECT MATHEMATICAL REPRESENTATIONS.
Visual representations can help students get a better understanding of abstract concepts and help her engage in mathematical discourse (Tripathi, 2008).
- 4** FACILITATE MEANINGFUL MATHEMATICAL DISCOURSE.
Discourse gives students the opportunity to share ideas and clarify understandings, construct arguments, and develop a language for expressing mathematical ideas (NCTM 2000).

Figure 4.3. Best Math Practices 1-4.

edu Encouraging Academic Conversations ...



Video from Edutopia

Figure 4.4. Video: Encouraging Academic Conversations with Talk Moves.

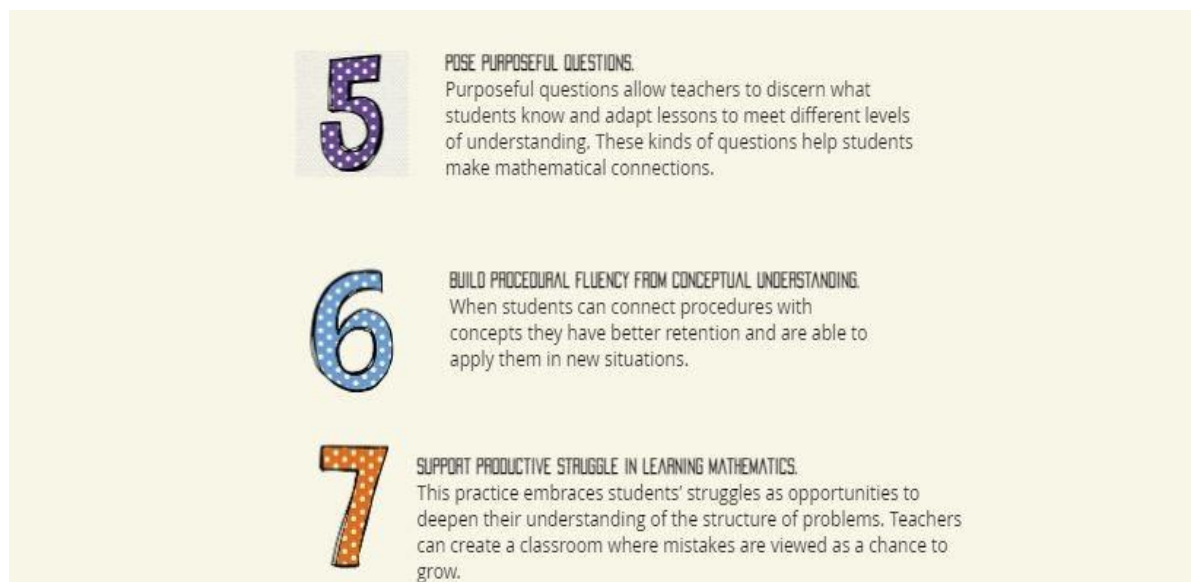


Figure 4.5. Best Math Practice 5-7.

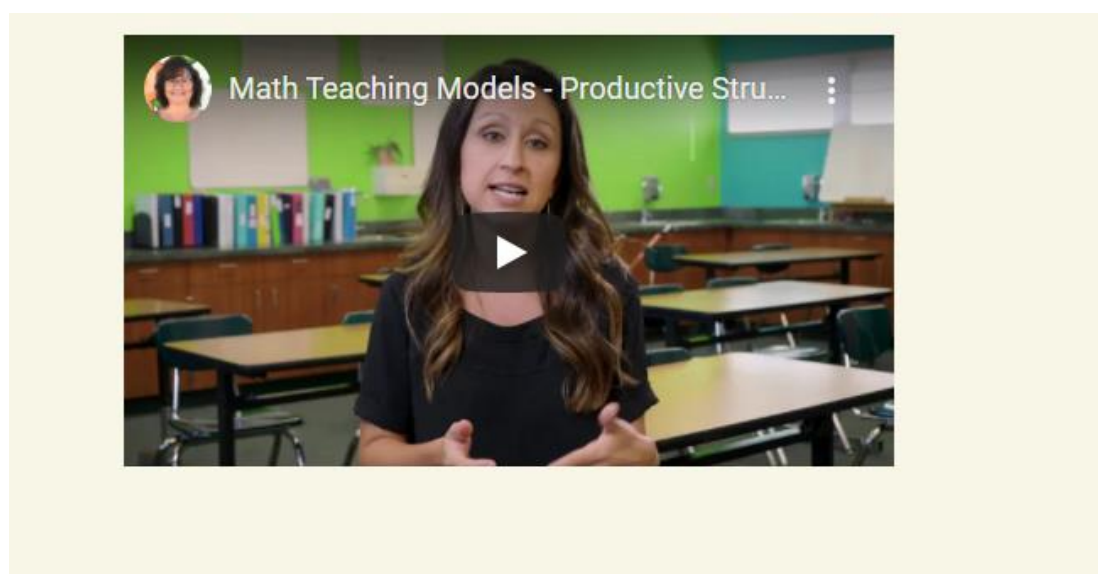


Figure 4.6. Video: Math Teaching Models Productive Struggle.

SCAFFOLDING DISCOURSE FOR CLD STUDENTS





 <p>ASK OPEN-ENDED QUESTIONS OF ALL STUDENTS</p> <p>Teachers should also have an academic wall, students will learn the mathematical vocabulary (Banse et.al, 2016, p. 102).</p>	 <p>SCAFFOLD CLD WITH CLASS-ENDED QUESTION</p> <p>Use follow-up questions that teachers can use to guide students who are grappling with a more complex question (Banse et.al, 2016, p. 104).</p>	 <p>SCAFFOLD RESPONSE BY REVOICING</p> <p>Teachers should repeat, extend, and re-articulate students' responses using mathematical language that is more precise (Banse et.al, 2016, p. 105).</p>	 <p>MODEL VOCABULARY IN CONTEXT.</p> <p>Math has its own language, when students are exposed to in context vocabulary they can incorporate it and use it in their daily lives more effectively (Banse et.al, 2016, p. 106).</p>
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Figure 4.7. Scaffolding Discourse for CLD Students.

Mr. Fuentes
Gaming Specialist
Best Math Practices | Benefits of Gaming | Online Games | Games

Benefits of Gaming



Games engage learners in a way that motivates and encourages perseverance. They can make the classroom a more inviting environment. The benefits of gamification are supported by the self-determination theory and the self-efficacy theory.



- 1

- Promotes student autonomy through meaningful choices. Choices enable the personalization of learning, balancing the educator's learning goals with the students' goals and interests. Choice also encourages students to develop their metacognitive skills, it gives the chance to reflect on their learning and progress.
- 2

- Provides room for recovery to encourage risk-taking and exploration while maintaining rigor. In order for students to grow academically, they need to take risks, we need to engage them in a productive struggle with a low affective filter, which is what games provide. Students are more likely to seek challenges and see failures as learning opportunities.

Figure 4.8. Benefits of Gaming 1-2.

3

- Builds competence through authenticity. Utilizing games during class can help students develop disciplinary skills, frameworks, and thinking skills. It sets students in an authentic learning environment, where they can self-assess and obtain mastery through practice.

4

- Cultivates belongingness to foster success for all students. Taking into consideration that a student's sense of belonging is a primary factor in student success and is often associated with academic achievement and persistence. This sense of belonging has been demonstrated to lower performance gaps for CLD students. Games promote inclusivity by clearly communicating the rules and expectations, students can make better choices if they understand their available choices and the expectations.

GAMES AS DIFFERENTIATION



Video from Edutopia

Figure 4.9. Video: Differentiating Instruction Through Interactive Games.

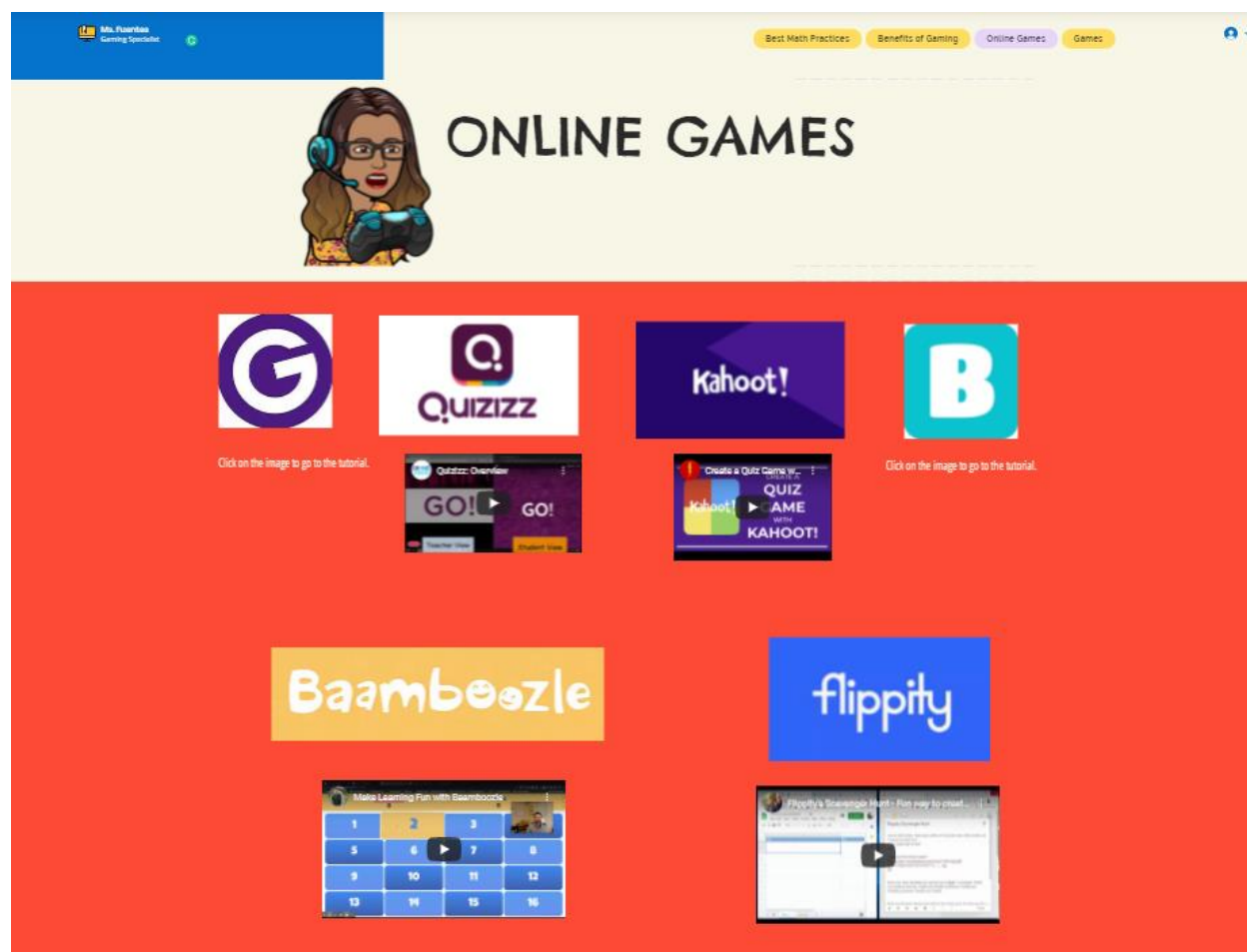


Figure 4.10. Online Games

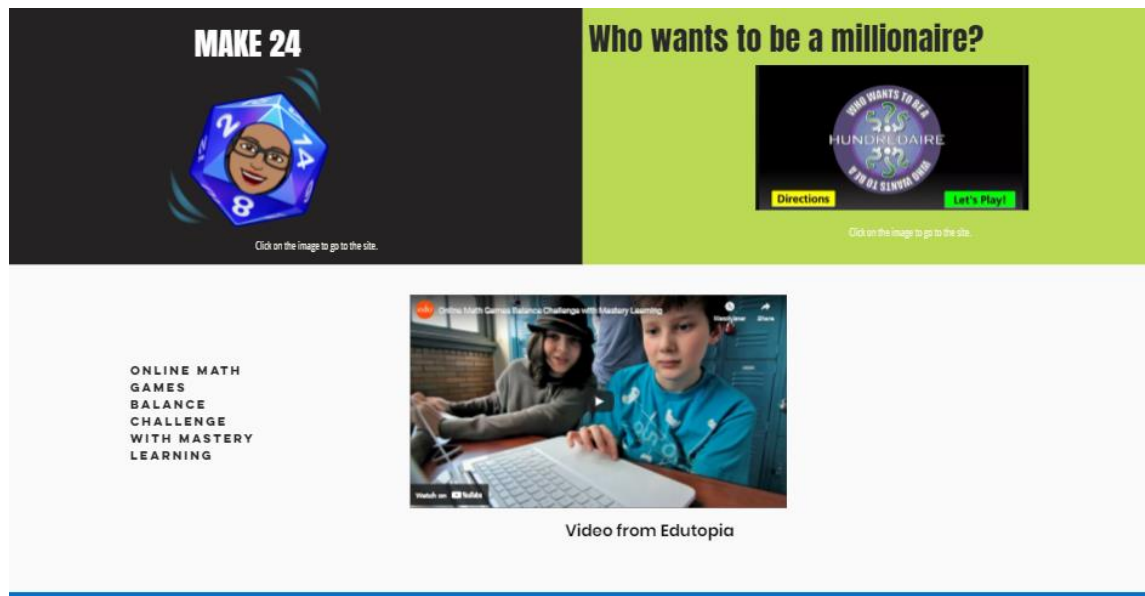


Figure 4.11. Video Online Math Games Balance Challenge with Mastery Learning.

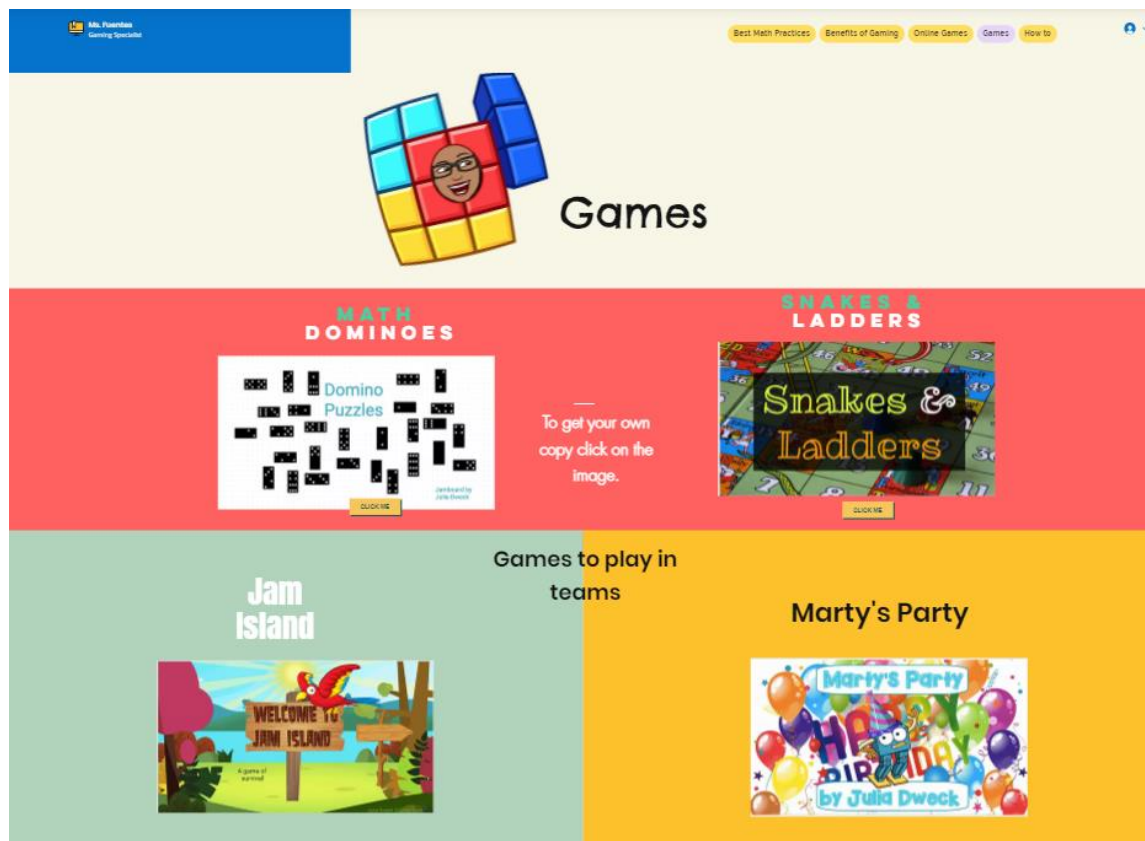


Figure 4.12. Games.

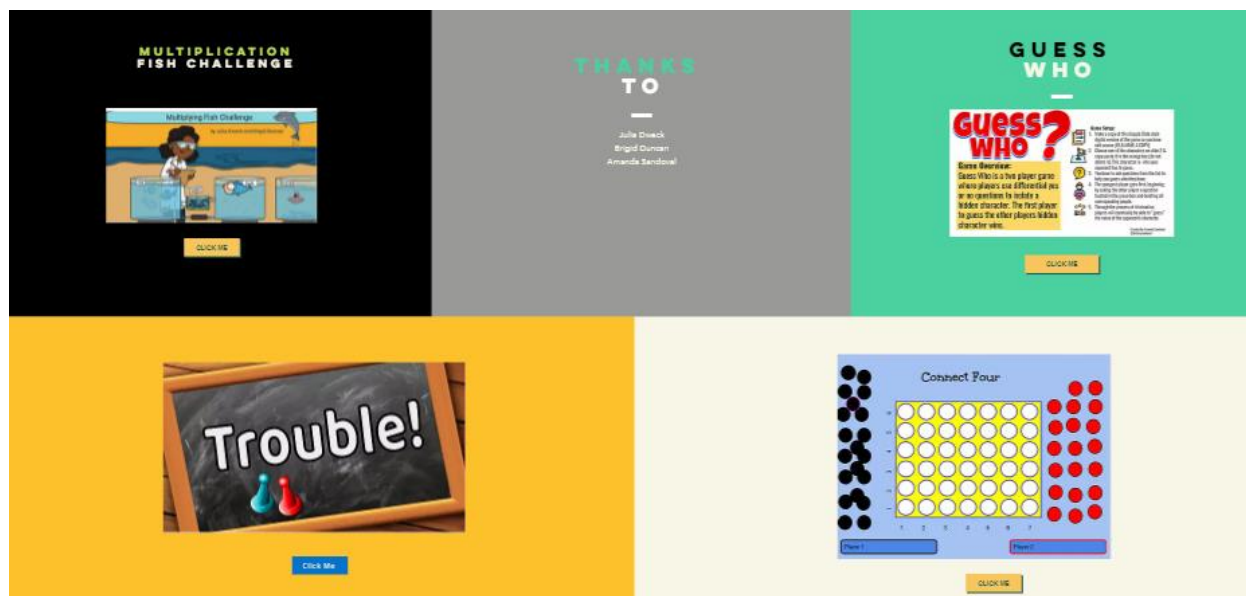


Figure 4.13. Online Games with links.



Figure 4.14. Board Game Tutorial.

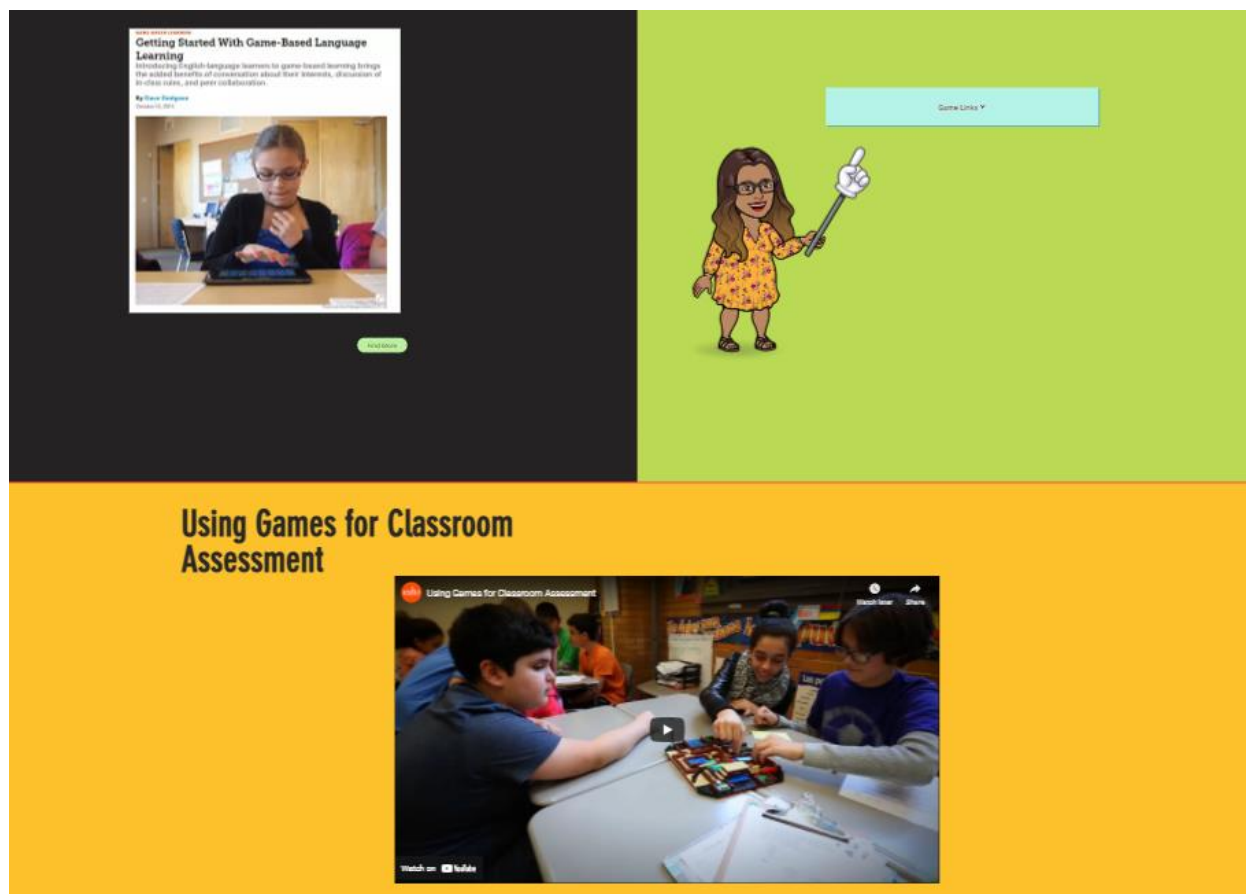


Figure 4.15. Video Using Games for Classroom Assessment.

References

- Abedi, J., Courtney, M., Leon, S., Kao, J., & Azzam, T. (2006). English language learners and math achievement: A study of opportunity to learn and language accommodation. *The Regents of the University of California*, 1- 92.
<https://files.eric.ed.gov/fulltext/ED495848.pdf>
- Ajlen, R., Plummer, B., Straub, E., & Zhu, E. (2020). Motivating students to learn: Transforming courses using a gameful approach. *CRLT Occasional Paper*, 40, 1–11.
<https://files.eric.ed.gov/fulltext/ED607303.pdf>
- Alexander, J. A., Cruz, L. E., & Torrence, M. L. (2019). Enhancing student engagement through gameful teaching and learning. *IDEA Paper*, 75, 1–17.
<https://files.eric.ed.gov/fulltext/ED594159.pdf>
- Armstrong, P. (2010). *Bloom's taxonomy*. Vanderbilt University Center for Teaching.
<https://cft.vanderbilt.edu/guides-sub-pages/blooms-taxonomy/>.
- Banase, H. W., Palacios, N. A., Merritt, E. G., & Rimm-Kaufman, S. E. (2016). 5 strategies for scaffolding math discourse with ELLs: Eliminate obstacles to effective classroom communication with these research-tested suggestions. *Teaching Children Mathematics*, 23(2), 100–108. <https://doi.org/10.5951/teacchilmath.23.2.0100>
- Barata, G., Gama, S., Gonçalves, D., & Pires, J. A. (Eds.). (2013). *Improving participation and learning with gamification*. Proceedings of the 1st International Conference on Gamification. Toronto, Ontario, Canada. <https://doi.org/10.1145/2583008.2583010>
- Blackburn, B. R. (2018, December 13). *Productive struggle is a learner's sweet spot*.

ASCD.org.

<http://www.ascd.org/ascd-express/vol14/num11/productive-struggle-is-a-learners-sweet-spot.aspx>

Boykin W. & Noguera, P. (2011). *Creating the opportunity to learn: Moving from research to practice to close the achievement gap*. ASCD.

Brown, C. L. (2005). Equity of literacy-based math performance assessments for English language learners. *Bilingual Research Journal*, 29(2), 337-363, 497.

<http://libproxy.greensboro.edu:2048/login?url=https://www.proquest.com/scholarly-journals/equity-literacy-based-math-performance/docview/222006731/se-2?accountid=11207>

Chien, C. W. (2012). Differentiated instruction in an elementary school EFL classroom. *TESOL Journal*, 3(2), 280–291. <https://doi.org/10.1002/tesj.18>

Common Core State Standards Initiative. (2021). *Grade 5: Introduction*. Common Core State Standards Initiative. <http://www.corestandards.org/Math/Content/5/introduction/>

Cross, D. I., Adefope, O., Rapacki, L., Hudson, R. A., Lee, M. Y., & Perez, A. (2012). Success made probable: Creating equitable mathematical experiences through project-based learning. *Journal of Urban Mathematics Education*, 5(2), 55–86.

https://www.researchgate.net/publication/281961341_Success_made_probable_Creating_equitable_mathematical_experiences_through_project-based_learning

Di Muro, P. (2006). Best practices for mathematics instruction: Teaching for understanding. *NADE Digest*, 2 (1), 1-8. <https://files.eric.ed.gov/fulltext/EJ1097786.pdf>

Dweck, C.S. (2006). *Mindset : The new psychology of success*. Random House Incorporated.

- Gamlo, N. (2019). The impact of mobile game-based learning language apps on EFL learners' motivation. *English Language Teaching*, 12(4), 49–56. <https://doi.org/10.5539/elt.v12n4p49>
- Gladman, A. (2014). Team teaching is not just for teachers! Student perspectives on the collaborative classroom. *TESOL Journal*, 6(1), 130–148. <https://doi.org/10.1002/tesj.144>
- Gonzalez, R. J., Pagan, M., Wendell, L., & Love, C. (2011). *Supporting ELL/culturally and linguistically diverse students for academic achievement*. The International Center for Leadership in Education.
- Hammond, Z. L. (2014). *Culturally responsive teaching and the brain: Promoting authentic engagement and rigor among culturally and linguistically diverse students* (1st ed.). Corwin.
- Hanson-Smith, E. (2016). Games, gaming, and gamification: Some aspects of motivation. *TESOL Journal*, 7(1), 227–232. <https://doi.org/10.1002/tesj.233>
- Huh, K., & Lee, J. (2019). Fostering creativity and language skills of foreign language learners through SMART learning environments: Evidence from fifth-grade Korean EFL learners. *TESOL Journal*, 11(2), 1–17. <https://doi.org/10.1002/tesj.489>
- Jourdain, L., & Sharma, S. (2016). Language challenges in mathematics education: A literature review. *Waikato Journal of Education*, 21(2), 43–53. <https://eric.ed.gov/?q=Language+challenges+in+mathematics+education%3a+A+literature+review&id=EJ1233433>
- Learning Sciences International: Marzano Center. (2018, November 10). *3 types of learning targets*. Learning Sciences International: Marzeno Center. <https://www.marzanocenter.com/3-types-of-learning-targets/>

- Maurer, K., Hudiburgh, L., & Werwinski, L. (2020). What do students gain from games? Dice games vs word problems. *Teaching Statistics*, 42(2), 41–46.
<https://doi.org/10.1111/test.12214>
- McNeil, L. (2018). Introducing teachers to digital game–enhanced pedagogy: Successes and challenges in a graduate course. *TESOL Journal*, 9(3), 580–584.
<https://doi.org/10.1002/tesj.383>
- Means, B., & Knapp, M. S. (1991). Cognitive approaches to teaching advanced skills to educationally disadvantaged students. *Phi Delta Kappan*, 73(4), 282–289.
https://www.researchgate.net/publication/234590664_Cognitive_Approaches_to_Teaching_Advanced_Skills_to_Educationally_Disadvantaged_Students
- National Council of Teachers of Mathematics. (2014). *Principles to actions: Ensuring mathematical success for all*.
- National Council of Teachers of Mathematics.(2001).*Adding it up: Helping children learn mathematics*. The National Academies Press. <https://doi.org/10.17226/9822>.
- Okilwa, N.A. & Robert, C. (2018). Teacher leadership. *The TESOL Encyclopedia of English Language Teaching*. DOI:10.1002/9781118784235.eelt0875
- Pang, Y. (2010). Working effectively with ELLs: What public school teachers should know. *New England Reading Association Journal*, 45(2), 69-75,103.
- Payant, C., & Bright, R. (2017). Technology-mediated tasks: Affordances considered from the learners’ perspectives. *TESOL Journal*, 8(4), 791–810. <https://doi.org/10.1002/tesj.333>
- Peregoy, S., & Boyle, O. (2017). *Reading, writing and learning in ESL: A resource book for teaching K-12 English learners* (7th ed.). Pearson.
- Rachels, J. R. (2016). *The effect of gamification on elementary students' Spanish language*

achievement and academic self-efficacy (Order No. 10141916). ProQuest Central. .

<http://libproxy.greensboro.edu:2048/login?url=https://www.proquest.com/dissertations-theses/effect-gamification-on-elementary-students/docview/1823238499/se-2?accountid=11207>

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist*, 55(1), 68–78.

Smith, M. S., & Stein, M. K. (2018). *5 practices for orchestrating productive mathematics discussions* (2nd ed.). Corwin.

Stoynoff, S. (1993). Oxford's language learning strategies: What every teacher should know, *Bilingual Research Journal*, 17:1-2, 117-121, DOI: [10.1080/15235882.1993.10162651](https://doi.org/10.1080/15235882.1993.10162651)

TESOL International Association. (2018). *The 6 principles for exemplary teaching of English learners: Grades K- 12*.

Tripathi, P. N. (2008). Developing mathematical understanding through multiple representations. *Mathematics Teaching in the Middle School*, 13(8), 438.

<http://libproxy.greensboro.edu:2048/login?url=https://www.proquest.com/scholarly-journals/developing-mathematical-understanding-through/docview/231100073/se-2?accountid=11207>

U.S. Department of Education, National Center for Education Statistics. (2020). *The Condition of Education 2020* , [English Language Learners in Public Schools](https://nces.ed.gov/ipeds/data/2020/English_Language_Learners_in_Public_Schools).

https://nces.ed.gov/programs/coe/indicator_cgf.asp

